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CLAIMS

1. An apparatus for three dimensional inspection of an electronic part, wherein the apparatus is calibrated using a precision pattern mask with dot patterns deposited on a calibration transparent reticle, the apparatus for three dimensional inspection of an electronic part comprising:

(a) a camera and an illuminator for imaging the electronic part, the camera being positioned to obtain a first view of the electronic part;

(b) a means for light reflection positioned to reflect a different view of the electronic part into the camera, wherein the camera provides an image of the electronic part having differing views; and

(c) a means for image processing the image of the electronic part that applies calculations on the differing views of the image to calculate a three dimensional position of at least one portion of the electronic part.

2. The apparatus of claim 1 wherein the illuminator further comprises a ring light.

3. The apparatus of claim 1 wherein the means for light reflection further comprises a mirror.

4. The apparatus of claim 1 wherein the means for light reflection further comprises a prism.

5. The apparatus of claim 1 wherein the means for light reflection further comprises a curved mirror.

6. The apparatus of claim 1 wherein the electronic part further comprises a ball grid array.

7. The apparatus of claim 6 wherein the electronic part further comprises balls on a wafer.

8. The apparatus of claim 6 wherein the electronic part further comprises balls on a die.

9. The apparatus of claim 1 wherein the means for imaging provides the image to a frame grabber board.

10. The apparatus of claim 9 wherein the frame grabber board provides an image data output to a processor to perform a three dimensional inspection of a part.

11. The apparatus of claim 1 further comprising a nonlinear optical element to magnify the image in one dimension.

12. The apparatus of claim 1 wherein a maximum depth of

focus of a side perspective view allows for a fixed focus system to inspect larger electronic parts, with one perspective view imaging one portion of the electronic part and a second perspective view imaging a second portion of the electronic part.

13. The apparatus of claim 1 wherein a maximum depth of focus of a side perspective view includes an area of the electronic part including a center row of balls.

14. The apparatus of claim 13 wherein all of the balls on the electronic part are in focus resulting in two perspective views for each ball.

15. The apparatus of claim 1 further comprising a means for inspecting gullwing and J lead devices.

16. A method for three dimensional inspection of a lead on a part, the method comprising the steps of:

(a) using a camera to receive an image of the lead;

(b) transmitting the image of the lead to a frame grabber;

(c) providing fixed optical elements to obtain a side perspective view of the lead;

(d) transmitting the side perspective view of the lead to the frame grabber;

(e) operating a processor to send a command to the frame grabber to acquire images of pixel values from the camera; and

(f) processing the pixel values with the processor to calculate a three dimensional position of the lead.

17. The method of claim 16 wherein the step of processing the pixel values further comprises determining state values from the part itself.

18. The method of claim 16 wherein the lead is a curved surface lead.

19. The method of claim 16 wherein the lead is a ball.

20. The method of claim 16 wherein the part is a ball grid array.

21. The method of claim 16 wherein the processor processes the pixel values to find a rotation, an X placement value and a Y placement value of the part relative to world X and Y coordinates by finding points on four sides of the part.

22. The method of claim 21 further comprising the steps of:

(a) using a part definition file that contains measurement values for an ideal part;

(b) calculating an expected position for each lead of the part for a bottom view using the measurement values from the part definition file and the X placement value and Y placement value.

23. The method of claim 16 further comprising the step of using a search procedure on the image to locate the lead.

24. The method of claim 16 further comprising the step using a subpixel edge detection method to locate a reference point on each lead.

25. The method of claim 16 further comprising the step of determining a lead center location and a lead diameter in pixels and storing the lead center location and lead diameter in memory.

26. The method of claim 25 further comprising the step of calculating an expected position of a center of each lead in the side perspective view in the image using a known position of the side perspective view from calibration.

27. The method of claim 25 further comprising the step of converting the pixel values into world locations by using pixel values and parameters determined during calibration wherein the world locations represent physical locations of the lead with respect to world coordinates defined during calibration.

28. The method of claim 27 wherein a Z height of each lead is calculated in world coordinates in pixel values by combining a location of a center of a lead from a bottom view with a reference point of the same lead from a side perspective view.

29. The method of claim 28 further comprising the step of converting the world coordinates to part values using a rotation, X placement value and Y placement value to define part coordinates for an ideal part where the part values represent physical dimensions of the lead including lead diameter, lead center location in X part and Y part coordinates and lead height in Z world coordinates.

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30. The method of claim 29 further comprising ~~the step of~~ comparing ideal values defined in a part file to calculate deviation values that represent a deviation of the center of the lead from its ideal location.

31. The method of claim 30 wherein the deviation values may include lead diameter in several orientations with respect to an X placement value and a Y placement value, lead center in the X direction, Y direction and radial direction, lead pitch in the X direction and Y direction and missing and deformed leads, further comprising the step of calculating the Z dimension of the lead with respect to a seating plane based on Z world data.

32. The method of claim 31 further comprising the step of comparing the deviation values to predetermined tolerance values with respect to an ideal part as defined in a part definition file to provide a lead inspection result.

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